

1 **Will Automated Vehicles Solve the Truck Driver Shortages? Perspectives from**
2 **the Trucking Industry**

3 **Amy M. Schuster**

4 Department of Psychology

5 Clemson University, Clemson, SC 29634, USA

6 Email: amschus@clemson.edu

7 ORCID: <https://orcid.org/0000-0002-4472-0283>

8 **Shubham Agrawal¹**

9 Department of Psychology

10 Clemson University, Clemson, SC 29634, USA

11 Email: agrawa3@clemson.edu

12 ORCID: <https://orcid.org/0000-0002-0990-9785>

13 **Noah Britt**

14 College of Engineering, Computing and Applied Sciences

15 Clemson University, Clemson, SC 29634, USA

16 Email: nbritt@clemson.edu

17 **Danielle Sperry**

18 Department of Psychology

19 Clemson University, Clemson, SC 29634, USA

20 Email: ds@designforce.me

21 **Jenna A. Van Fossen**

22 Department of Psychology

23 Michigan State University, East Lansing, MI 48824, USA

24 Email: vanfos10@msu.edu

25 **Sicheng Wang**

26 Department of Geography

27 University of South Carolina, Columbia, SC 29208, USA

28 Email: wangsic4@msu.edu

29 ORCID: <https://orcid.org/0000-0001-6395-6235>

30 **Elizabeth A. Mack**

31 Department of Geography, Environment, and Spatial Sciences

32 Michigan State University, East Lansing, MI 48824, USA

33 Email: emack@msu.edu

34 ORCID: <https://orcid.org/0000-0002-1829-8787>

35 **Jessica Liberman**

36 Department of Sociology, Anthropology, and Criminal Justice

37 Clemson University, Clemson, SC 29634, USA

38 Email: jliberm@clemson.edu

39 ORCID: <https://orcid.org/0000-0002-4357-8983>

40 **Shelia R. Cotten**

41 Department of Sociology, Anthropology, and Criminal Justice

1 Department of Communication
2 Clemson University, Clemson, SC 29634, USA
3 Email: scotten@clemson.edu
4 ORCID: <https://orcid.org/0000-0002-8657-8262>

5
6
7

1 **Abstract**

2 The United States (U.S.) has experienced persistent truck driver shortages for the past several
3 decades, as demand for truckers has increased while individuals willing to fill driving jobs have
4 decreased. Studies in the transportation literature have not examined industry views on driver
5 shortages, which are expected to become more severe, in combination with trucking industry
6 perspectives on the impact of automated vehicles (AVs) on driving jobs. This study addresses these
7 knowledge gaps through focus groups with trucking industry participants (N = 67) working in
8 three organizational levels (25 upper-level management or owners, 20 supervisors or dispatchers,
9 and 22 drivers) and a supplemental online survey. Using an inductive thematic analysis approach,
10 findings indicate that companies struggle to address driver shortages because of difficulties
11 recruiting younger workers related to quality-of-life issues, job requirements, and low rates of pay.
12 AVs were thought to be a potential solution to the driver shortage, although there will be a
13 continued need for drivers to perform certain tasks. The potential changes in industry positions
14 could attract new workers but would require older workers to adapt to using new technology. From
15 a workforce development perspective, training programs targeting technicians and drivers can help
16 prepare the trucking workforce for an autonomous future.

17
18 **Keywords:** Truck drivers; Trucking industry; Driver shortages; Automated vehicles; Focus
19 groups
20

1 **1. Introduction**

2 Trucking is one of the most important industries in the United States (U.S.). In 2020, the U.S.
3 trucking industry transported about 10.2 billion tons of freight across the country, representing
4 72.5% of the total domestic tonnage with an estimated value of over \$732 billion (1). Much of this
5 is due to a truck's ability to complete the "last mile" delivery of products, as other modes of
6 shipping such as rail and water lack the infrastructure needed to reach necessary distribution
7 centers and end product locations (2). The importance of the trucking industry is further
8 highlighted by its position as a major employer in the U.S. In 2020, the trucking industry employed
9 7.65 million Americans, or about 5.8% of the entire country's workforce (3); 3.36 million
10 employed in the industry are truck drivers (1).

11 Unfortunately, persistent truck driver shortages continue to plague the trucking industry,
12 making it a critical issue in the industry (4). In 2021 the number of unfilled truck driving positions
13 in the U.S. industry was estimated to be around 80,000 and is expected to reach 160,000 by 2030
14 (5). Truck-based freight demand is expected to increase rapidly due to the growth of e-commerce
15 (2), which may further exacerbate driver shortages in coming years. Several attempts have been
16 made to reduce the driver shortage and mitigate its negative effects on the economy. For example,
17 the federal government recently released a plan to address the shortage by creating advisory boards
18 and task forces commissioned to develop apprenticeship programs to train and produce qualified
19 drivers (6). This plan includes speeding up the process of issuing commercial driver's licenses,
20 expanding apprenticeship programs with industry partners, and connecting veterans to truck
21 driving career pathways (7). Trucking companies have also attempted to make the driving
22 occupation more appealing through increased benefits and pay (8); however, the average heavy
23 and tractor-trailer truck driver's pay (\$53,090) still falls short of the national average for all
24 occupations (\$61,900) (9). There have also been calls for amending the minimum age requirement
25 standards which would lower the minimum age requirement of 21 years to 18 years for interstate
26 driving (10). This has been met with some success, as apprenticeship pilot programs have begun
27 to be implemented with younger drivers (18-20 years) in preparation for such regulatory changes
28 (11). Ironically, some efforts to improve drivers' working conditions may have exacerbated the
29 shortage. For example, the Hours-of-Service regulation, which limits the amount of time that
30 drivers may spend behind the wheel, has been criticized for limiting driver productivity and
31 worsening the driver shortage (2).

32 Given recent advances in automated vehicle (AV) technologies, several public and industry
33 stakeholders seek to leverage them in the trucking industry to alleviate driver shortages, reduce
34 operating costs, and increase safety (12-15). However, most existing research related to AVs and
35 the U.S. trucking industry has focused on their expected adoption timeline, workforce impacts, or
36 economic benefits based on industry expert interviews or scenario analysis (16-18). Some studies
37 have investigated the trucking industry workers' perceptions of AVs and their impacts on the
38 trucking industry in a non-U.S. context (14, 19). However, the introduction of AVs in the U.S.
39 may be more tumultuous for trucking companies and drivers, compared to other countries, due to
40 the size of the country (19) and weaker social safety net (20). In this context, we examine the
41 perceptions of U.S. trucking industry workers at three organizational levels (i.e., upper-level
42 management, supervisors or dispatchers, and drivers) to understand the potential impacts of AVs
43 on the driver shortage.

1 **2. Background**

2 *2.1. Truck Driver Shortages*

3 Truck driver shortages have been cited as one of the major problems in freight and logistics
4 (21, 22). Research about the trucking industry highlights several factors behind the driver shortage
5 problem including job demands, challenging working conditions, and health-related concerns (23,
6 24). One of these factors is the inability to attract younger workers, which means the trucking
7 workforce is aging. The median truck driver is 46 years old (25), and the proportion of drivers who
8 are 65 years-old or older is growing (26). Younger workers may be less interested in becoming
9 drivers because of the more intensive physical and psychological job demands of truck driving
10 (27) and greater prevalence of alternative career options (e.g., construction) (28). At the same time,
11 trucking companies often prefer to hire drivers with more than two years of driving experience to
12 meet safety concerns and insurance requirements (28), which could dissuade younger workers
13 from pursuing truck driving as a career. Additionally, truck driving is male-dominated, with
14 women representing only 6.6% of the driver population (28). Entrenched masculinity within the
15 trucking industry may serve as a deterrent for women to enter driving jobs (29). Women seem to
16 view the profession as a short-term opportunity and fear sexism, as well as potential harassment
17 and assault in the workplace (30). Although recruitment strategies focused on female and minority
18 populations have been discussed (31), thus far, there is a lack of progress in broadening
19 participation to combat the driver shortage.

20 Lifestyle issues are often referenced as a reason why drivers may wish to transition into a
21 different occupation (5, 28). Truck driving is a physically and mentally demanding occupation
22 (32). Drivers' work hours are often irregular, making it more difficult for them to engage in healthy
23 behaviors such as exercising and eating nutritional meals (33). Many new drivers are often
24 assigned atypical work schedules that may require that they spend long amounts of time away from
25 their home and social network (28). This social isolation may lead to negative health effects,
26 including feelings of loneliness, depression, and anxiety (34). Lack of respect for the occupation
27 and poor treatment by shipping and receiving staff can compound work stress (35, 36). There are
28 several safety risks involved in truck driving (37), such as inclement weather, poor road conditions,
29 driving hazards, and the potential of experiencing violence that may further impair driver well-
30 being (36). Drivers who are fatigued or suffering from poor mental health are at a higher risk of
31 being involved in a traffic accident (38). Yet despite these stresses, 80% of truck-car accidents are
32 caused by car drivers (39) and compared to passenger vehicles drivers, truck drivers have a lower
33 rate per mile traveled of crashes (40).

34 Adequate compensation has also been a long-standing issue within the trucking industry,
35 especially considering the lack of pay for non-driving hours (41). While the average hourly wage
36 for heavy-duty truck and trailer drivers appears high \$25.52 (9), it does not account for
37 uncompensated work, delays or detention times, or overtime compensation, since the Fair Labor
38 Standards Act exempts employers from having to pay drivers overtime (42). However, pay is not
39 the only factor behind the persistent driver shortage (43), as "driver churning" (i.e., drivers moving
40 from one company to another without a pay increase) accounted for almost 80% of the driver
41 shortage problem in the U.S. (44). Instead, drivers may turnover to gain better working conditions

1 (45) or when it becomes clear that management purposefully misled them about their role
2 requirements (46).

3 In addition to the day-to-day work-related stresses that truck drivers contend with, they also
4 have had to adapt to several changes that have affected the trucking industry. One of these notable
5 changes is a shift in manufacturing away from practices that involved holding large inventories to
6 practices related to “just-in-time inventory,” which helps manufacturers reduce inventory costs by
7 getting supplies transported on demand (47, 48). This shift places more demand on truck drivers
8 to deliver inputs to meet fluctuating consumer demand.

9 The recent growth in the e-commerce sector further changed the paradigm for supply chain
10 management with the creation of more, near-to-destination distribution centers as opposed to
11 spread out, giant inventory management areas (49). These supply chain transitions not only
12 increased the demand for truck drivers, but also changed their responsibilities in terms of how far
13 and how frequently goods are delivered. Another technological change that negatively impacted
14 drivers is the implementation of mandated electronic logging for drivers to accurately track hours
15 of service and shipments (50). This change led to a decrease in driver salaries and more reckless
16 driving behavior to complete deliveries on time, especially for perishable goods (51). Further,
17 several large motor carriers are partnering with retailers to offer value-added services for
18 customers on their deliveries (e.g., installation of home appliances). These partnerships require
19 more training for drivers to navigate residential neighborhoods and provide service to customers
20 (52).

21 Federal regulations also played an important role in exacerbating the truck driver shortage.
22 Over the last two decades, regulations enacted that were intended to provide safeguards for
23 overworked truck drivers yielded unintended consequences for drivers. For example, the federal
24 Hours-of-Service (HOS) regulation limits the maximum number of driving hours (60 hours/7 days
25 or 70 hours/8 days) with a 34-hour rest period. This law means truck drivers are off-duty for 10
26 hours each day (53). Although, drivers have the option to split the 10-hour off duty, either as an
27 8/2 or 7/3, with neither counting against the 14-hour driving window (53). Importantly, these off-
28 duty time splits can result in inconsistent driving hours that do not account for drivers’ circadian
29 rhythms and can lead to increased levels of emotional and physical exhaustion (54). In 2020, the
30 HOS regulations were amended to require a 30-minute break after eight total hours of driving time
31 (including time on-duty, but not driving) (55). While the HOS regulation could reduce the number
32 of fatigue-related crashes (56), an unintended consequence of the regulation is the intense time
33 pressure drivers feel to complete their job in a shorter amount of time, leading to stress and
34 emotional exhaustion (57).

35 The COVID-19 pandemic greatly impacted the trucking industry and in many ways,
36 exacerbated truck driver shortages (58, 59). In the early days of the pandemic, trucking companies
37 changed their business models to transport different types of goods, based on consumer demand,
38 or to avoid additional costs (60). Many drivers also left the workforce at this time. From May 2020
39 through December 2020, nearly 13% of workers in the U.S. trucking industry were unable to work
40 due to COVID-19 (61). Those workers that remained in the trucking industry reported
41 unprecedented hardships throughout 2020 and into 2021 (60). On top of the risk of contracting the
42 virus, drivers had issues accessing receiving facilities and struggled to fulfill basic needs (e.g.,
43 showers and meals) while on the road (60). Team driving, where two drivers cooperatively operate

1 a vehicle, significantly declined as a result of the COVID-19 pandemic (62). Team driving has
2 been thought to help reduce worker fatigue and loneliness while adhering to productivity and
3 hours-of-service requirements (63), and its reduction may be a potential antecedent for increased
4 voluntary turnover. The impacts of COVID-19 on the global supply chain also resulted in intense
5 scrutiny on the truck driver shortage whose impacts on consumers were highly visible at this point
6 in time (64).

7

8 *2.2. Automated Vehicles and the Trucking Industry*

9 Above and beyond removing the need to recruit, retain, and compensate drivers, which will
10 impact the ongoing driver shortages, there are several other reasons the trucking industry is a very
11 likely candidate to be the first adopter of AV technology in the U.S. AVs are categorized based on
12 six levels of automation. At level 0 there is no automation, and a human is performing all the
13 driving tasks. In level 3, a human is not driving, although a human is still needed to be in the
14 driver's seat in case there is a need to take over driving when automated conditions are not met,
15 such as maneuvering through a traffic jam. AV level 5 operates without human assistance
16 everywhere and in all conditions (65). Unlike passenger cars, a majority of truck miles are traveled
17 on highways (66), which are less complicated and more predictable than other types of roads (e.g.,
18 city streets) (67, 68). Second, the integration of AV technologies in trucking could reduce the
19 number and severity of road accidents (12, 69). Third, research shows AVs can increase profit
20 margins of trucking companies by reducing fuel costs by 5-10% (12, 70). AVs could also reduce
21 costs associated with driver wages and benefits, which accounted for about 44% of the total
22 marginal cost per mile in 2020 (71).

23 When AVs will be rolled out in the trucking industry is uncertain and subject to a variety of
24 factors including the level of automation, type of trucking industry, technology availability, and
25 public opinion. Accordingly, studies offer varied predictions about AV deployment timelines (16,
26 18, 72, 73). A European industry report provides some indication about what the rollout of AVs
27 may look like for the trucking industry by 2030 (74). The first phase will involve platooning of
28 trucks on highways with a driver in the leading truck only. In the second phase, trucks will have
29 full autonomy on highways, but will require a driver to pick-up and drop-off trucks at designated
30 truck stops. In the third phase, trucks will be able to operate on all highways without driver
31 involvement at any point in the trip. Recently, AV technology developers, such as Waymo and
32 TuSimple, started publicly testing automated trucks in the U.S. sometimes in partnership with
33 freight-hauling companies (e.g., C.H. Robinson) to demonstrate their effectiveness in improving
34 supply chains (75, 76).

35 The impacts of AVs on the driving workforce vary. Some studies suggest that AVs are a threat
36 to driving jobs (77). Mohan & Vaishnav (2022) estimate that a transfer-hub operation model for
37 trucks, with full-automation driving on less complex highways, and humans driving on more
38 complex regional routes, could impact 30,000 to 500,000 truck driving jobs, depending on the
39 region and weather conditions (78). Some studies are less pessimistic about the impact on jobs and
40 suggest that level 4 AVs will not completely eliminate the need for drivers, because people will
41 still be needed for non-driving tasks (79) or to guide a platoon of AVs in dense areas (80). Other

1 studies suggest AVs may be the solution to the chronic driver shortage problem in the industry
2 (75, 76).

3 Some studies have investigated the perceptions of trucking industry workers towards AVs, but
4 in a non-U.S. context and not specifically about driver shortages (14, 19). Other studies have
5 analyzed trucking manager's perceptions of AVs within the U.S. (81). However, the nexus of
6 perceptions regarding driver shortages and the utility of AVs in resolving this issue in the U.S. has
7 yet to be examined. The present study addresses this knowledge gap by analyzing survey data and
8 focus group interviews of trucking industry workers to investigate: (i) their attitudes about the
9 driver shortage, (ii) the strategies they use to deal with the driver shortage, and (iii) their
10 perceptions of automated trucks and their adoption to alleviate the persistent driver shortage in the
11 industry.

12 **3. Methods**

13 *3.1. Participant Recruitment*

14 We recruited U.S. trucking industry workers at three organizational levels: upper-level
15 management or owners ("managers" group), supervisors or dispatchers ("supervisors" group), and
16 drivers ("drivers" group), to participate in the study through convenience sampling. Managers
17 were recruited by telephone calls made to trucking companies located in one Midwest and one
18 Southern U.S. state, advertisements placed in trucking association newsletters, and professional
19 contacts of members of the research team. Supervisors and drivers were recruited by advertising
20 posts placed on social media (Facebook, Instagram, Reddit, and Twitter) and participant
21 recruitment service (Respondent.io) platforms. Advertisements contained a weblink that directed
22 interested parties to complete a pre-screening survey to help determine eligibility. A member of
23 the research team followed up with potential participants to verify that inclusion criteria for the
24 study had been met: (i) they worked in the trucking industry (manager, supervisor, or driver) and
25 (ii) they worked in the U.S. Snowball sampling was also used in participant recruitment. All
26 participants were asked to provide contact information of colleagues in the trucking industry that
27 might be interested in our study and were encouraged to share information with them. Those who
28 met the inclusion criteria were scheduled for a focus group and received an email with the consent
29 form, virtual focus group information, and a link to the online survey.

30 31 *3.2. Data Collection*

32 Data were collected between June 2020 and January 2022 through focus groups and a
33 supplementary online survey and with trucking industry workers (N=67). The focus group protocol
34 and questions for the online survey were developed from knowledge gaps in the transportation
35 literature. We pilot tested the focus group protocol and online survey with ten industry experts and
36 revised based on the experts' feedback. Participants completed the online survey prior to the focus
37 group. The online survey asked questions to collect the following information: organizational
38 tenure, perceptions about the impacts of AVs on an organization's workforce, and projections
39 about the impact of AVs on the size of the U.S. workforce, and demographics (age, gender,
40 race/ethnicity). Organizational tenure was assessed by an open-ended question, *how long have you
41 worked for your current organization?* Perceptions about the impacts of AVs on an organization's

1 workforce was measured by, *how do you think that automated vehicles will affect the size of the*
2 *U.S. workforce?* Response options included the workforce will decrease in size, will stay the same
3 in size, or increase in size. Projections about the impact of AVs on the size of the U.S. workforce
4 was assessed by, *do you expect the size of your organization's workforce to increase, stay the*
5 *same, or decrease in the next 2, 5, and 10 years as a result of automated vehicles?* Response
6 options for each year (i.e., 2, 5, 10) included decrease in size, stay the same, or increase in size.
7 One manager and one driver did not complete the online survey.

8 Thirty-seven focus groups were conducted virtually on Zoom with trucking managers (n = 25),
9 supervisors (N=20), and truck drivers (N=22). Focus groups consisted of a moderator, two note
10 takers, and one to four participants. All participants provided informed consent prior to the start of
11 the focus group. A semi-structured protocol was used to guide each focus group. At the onset of
12 each focus group, the moderator briefly described the six SAE levels of vehicle automation (65)
13 and informed the participants that the interview would focus on the higher levels, including levels
14 2-5. Participants were asked open-ended questions about driver's experience in the trucking
15 industry. *What are the biggest challenges you encounter in your job currently? Do you foresee*
16 *any challenges moving forward?* Participants were also asked open-ended questions about the
17 future of AVs in the trucking industry. *What do you think will be the impact of AVs on the job of*
18 *truck driving? How do you think AVs will impact your job, as well as the job of truck driving, in*
19 *2, 5, 10 years?* See Appendix A for the focus group protocol. The average duration of focus groups
20 was 72.8 minutes (SD: 25.0; range: 21-118). Due to the pandemic and no-show participants, some
21 of the focus groups only had one participant, which meant these focus groups were shorter
22 compared to those with multiple participants. Focus groups were audio recorded and transcribed
23 verbatim by a third-party transcription service.

24 The majority of participants were male (78%), White (69%), and, on average, 44.68 years old
25 (SD=12.46) and reflects the demographics of workers in the trucking industry. The composition
26 of the truck driver sample in this study is consistent with the U.S. truck driver demographics,
27 mainly male, White, and, on average aged, 46.6 years (82). Managers worked at their company the
28 longest, on average 20.79 years (SD =14.12). TABLE 1 presents participant characteristics.
29

30 [TABLE 1 About Here]

31 *3.3. Data Analysis*

32 Online survey data were analyzed descriptively. Focus group data were analyzed using an
33 inductive thematic approach because it is data driven and not reliant on a preexisting framework
34 (83). The inductive thematic analysis process consisted of six steps: (i) an initial review by research
35 team members; (ii) the creation of codes based on similar content; (iii) the organization of codes
36 based on themes; (iv) the analysis of themes based on coded quotes; (v) definition of themes; (vi)
37 formation of final analysis by the selection of relevant examples and connecting these examples
38 to research questions and relevant literature (84). Inter-coder reliability was established among the
39 two coders (graduate research assistants) with a Cohen's kappa value greater than or equal to 0.80.
40 NVivo software was used to assist with coding and to measure Cohen's kappa.

1 **4. Results**

2

3 *4.1. Online Survey Results: Workforce Impacts of AVs*

4 The majority of supervisors (50%) and drivers (62%) thought that AVs would reduce the size
5 of the U.S. workforce. Most participants thought the size of their organization's workforce would
6 stay the same in the next two (71%) to five years (58%). The responses about organization size in
7 ten years are more varied. Twenty-seven percent of respondents thought the size of their organization would increase while 32% thought the size of their organization would decrease. A
8 large proportion of managers (52%) reported their organization would stay the same in the next
10 ten years. See

1 TABLE 2 for workforce impacts of AVs.

2

3

[

1 TABLE 2 About Here]

2 *4.2. Focus Group Themes*

3 Focus group data contained three main themes. Theme one discussed participants'
4 explanations for persistent truck driver shortages. Theme two is focused on solutions to the driver
5 shortage. Theme three discusses viewpoints about AVs as a solution to the driver shortage.

6 *4.2.1. Theme 1: Driver Shortages.*

7 Participants described a constant struggle between the number of available truck driving jobs,
8 but rarely enough drivers to fill those jobs. A 57-year-old manager explained, "Today, drivers are
9 in very high demand and very short supply." As a result, participants were pessimistic about the
10 driver shortage ending. A 58-year-old manager shared, "I do think that there's going to be
11 continued shortage in our industry for truck drivers, whether you have automated vehicles or not.
12 It's going to be a challenge."

13 One of the factors discussed by participants influencing the gap in the driver shortage was the
14 aging workforce. As a 72-year-old manager noted, "At my company, my median age is 58 for my
15 fleet." Participants explained that their current workforce was older and closer to retirement, which
16 is a problem since there is not an influx of younger people training to become professional truck
17 drivers. Younger drivers were portrayed as uninterested in professional truck driving because of
18 low wages, the difficulty of the position, and the lack of respect for truck drivers. A 59-year-old
19 manager elaborated:

20
21 The old breed is moving out and retiring. Driving a truck is not a glamorous job. These young
22 people don't go to school to get a degree in truck driving. They want to be an engineer or a
23 chemist or a doctor or have a different profession than driving trucks. There could be a big
24 void there.

25
26 Aspects of quality of life such as physical and mental health, wealth, and leisure time were
27 factors considered to influence the driver shortage. Participants acknowledged that truck driving
28 is a stressful job physically and mentally. They elaborated that it is a hard job due to the long hours,
29 short breaks, and inconsistent work. A 27-year-old supervisor explained, "Sometimes these guys
30 can be out there for 14 hours a day behind the wheel and are just taking 30-minute breaks here and
31 there." Participants also noted other stresses that drivers encounter including a lack of respect by
32 dock workers, poor treatment by customers, and safety uncertainty related to the COVID-19
33 pandemic. A 27-year-old manager said, "There's a lot of stressful things that can happen. Traffic
34 can be bad. They can be treated really poorly, some of these customers, the people on the docks
35 are sort of rude, and other things." Since the role of a truck driver is difficult, drivers placed
36 importance on their compensation (wages and benefits) for their level of work. Drivers have
37 expectations about their wages and will not work unless they receive their desired level of income.
38 A 58-year-old manager stated, "People don't want to put in 12 hours only to make \$50,000 a year.
39 It's just not enough." Another quality-of-life aspect for truck drivers is that they want to be home
40 at night, not long-haul driving. A 33-year-old manager said, "Nobody wants to drive over the road.
41 It's a struggle. Everybody wants to be home daily."

1 Managers and supervisors also discussed experience as an element playing into the driver
2 shortage. A 57-year-old supervisor stated, “That’s the big challenge right there, is the drivers, and
3 that’s a very big challenge in trucking is not just getting any driver, getting a good driver.” Manager
4 and supervisor participants emphasized how difficult it was to hire a “good driver,” one who had
5 at least two years of experience, was capable in driving in extreme weather and in different regions,
6 had a commercial driver’s license (class A & B), and a safe driving record. A 58-year-old manager
7 shared, “For me, it’s a horrible thing to try to find a qualified driver. I think as the driver pool
8 keeps getting smaller...”

9 *4.2.2. Theme 2: Current Strategies Used to Address Driver Shortages.*

10 Participants described several strategies companies are implementing to address the persistent
11 driver shortage. One solution is to fill open positions with less experienced drivers. However, these
12 drivers require more oversight because they are undertrained and do not have the preferred skills
13 and experience. A 36-year-old manager explained:

14 ... with the insurance requirements we have, the youngest driver we can take is 21, and that
15 person has to have already 2 years of verified CDL-A experience, so that person doesn’t really
16 exist in the way that the system is set up right now. We have to move towards a model via
17 apprenticeship programs....

19
20 Trucking companies focus on trying to meet the drivers’ expectations about their wages by
21 providing better pay and company benefits. A 31-year-old supervisor described:

22
23 We are very competitive with our pay scales. We look at everyone and see what they’re paying,
24 and we try our best to be better if not, equivalent. We have new equipment, we have newer
25 trucks, and we have good managers that work with us.

26 However, if companies are unable to meet drivers’ compensation expectations, drivers will find
27 alternative employment at other trucking companies. As a 33-year-old supervisor explained,
28 “Retirement and health and job stability is always an issue for drivers. They’re always moving
29 around- they’re always looking for a company that’ll pay ‘em just a little bit more.” Some trucking
30 companies worked hard to try to accommodate their drivers’ desire to be home more frequently.
31 A 25-year-old supervisor explained:

33
34 A lot of companies, they’ll keep a driver out for two weeks at a time [70 hours] and send him
35 home for his 34-hour reset [federal regulation]... if you think about 34 hours, if you get home
36 at eight o’clock at night on a Saturday, then you leave out at 6 am on Monday, that’s really not
37 a lot of time at home. Especially after being gone for so long. Especially for people who have
38 kids and whatnot. We strive to not treat our drivers like that. We want them to have a life
39 outside of work.

40
41 Two managers shared that companies were branching outside of the U.S. to find truck drivers
42 as they struggle with the driver shortage. A 45-year-old manager explained:

1 Not only from the Southwest, but you have a lot of Eastern Europeans that are over here. Again,
2 you can't attract the driving force out of the American high schools, but these guys can come
3 over here with their family, drive a truck, and they make a living 10 times better than what
4 they had in their home country.
5

6 *4.2.3. Theme 3: AVs as a Solution to Driver Shortages.*

7 Participants had mixed opinions on whether AVs could be a plausible solution to easing the
8 driver shortage. Some participants thought that AVs would be beneficial. A 55-year-old manager
9 stated, "I look at the total jobs and the lack of filled positions right now, I think automation will
10 help fill that gap." But other participants were skeptical that AVs would be a solution to fixing the
11 driver shortage. A 52-year-old manager noted, "I certainly don't think it's going to solve the driver
12 shortage or have a large impact right out of the gate." Participants described three motivating
13 factors for how AV adoption could affect the driver shortage, including AVs as a solution, the
14 continued need for drivers, and the changing trends of industry positions.

15 A clear advantage shared by many participants was that automation, both partial and full,
16 would provide an incentive to be a truck driver for those currently in the field or those considering
17 employment within the industry. Participants stated a primary reason was the benefit to drivers on
18 the road, particularly in the circumstances of dropping off and picking up freight and safety due to
19 less accidents. A 55-year-old manager claimed, "If you could solve the backing in autonomously
20 right now, we could hire drivers way faster, couldn't we?" Participants also noted the appeal of
21 AVs to tech-savvy younger drivers. As explained by a 53-year-old manager, "I can see the younger
22 kids being more interested doing the computer stuff or running the vehicles like that, the trucks
23 like that." For those currently in the profession, participants were hopeful that the automation
24 would help solve their driver retention issues. A 40-year-old manager noted, "The reason why we
25 cannot get bigger because the drivers not coming to us and not staying with us. Once we have
26 automated truck, they're not going to be leaving us hopefully." Although, there were participants
27 who disagreed that AVs would be an incentive for truck drivers or future truck drivers due to the
28 potential for variability in job roles. A 27-year-old supervisor expressed:

29
30 ...most people are going to say like, "I don't want to go to driving school and learn how to
31 drive if... Yeah, I mean, there might be a job now, but in five years, I'm just going to have to
32 learn a new skill."

33
34 Participants' ideas about how the adoption of AVs may solve the shortage differed in
35 complexity. Some pointed out that AVs would allow companies to recruit less skilled drivers, with
36 a 57-year-old manager stating:

37
38 It's going to make, I guess, less skilled people available. Today, drivers are in very high
39 demand and very short supply. So, we think that automation is going to help us get some people
40 into driving that maybe we couldn't get in before.

41
42 Others did not know how exactly AVs could solve the truck driver shortage, but still pointed out
43 the correlation. A 59-year-old manager shared, "I think for the most part, the driver shortage has

1 been going on for the last few years. it would help alleviate that, as far as getting that from the
2 warehouse to the distribution center.”

3 Although participants held varying views on the feasibility and benefits of AVs, there was a
4 consensus that AVs would shift roles and industry positions. The shift in the age of drivers was
5 one of the changes related to AVs discussed by participants. Participants explained that with AVs,
6 newer, younger drivers, who already have technology experience, would begin to outnumber the
7 older, experienced drivers, who may not have the same technological knowledge or may not want
8 to learn how to use technology in their driving role. A 57-year-old driver explained:
9

10 It’s going to [weave] out the old people, the experienced and put lesser experienced people,
11 less cheaper people in the seats. And be able to take them like right out of college or which
12 you can’t do at this point, right out of high school and put them in a truck.

13
14 Participants also thought that AVs would cause a shift in industry positions to a more technical
15 skillset, which could ultimately create more jobs. A 60-year-old manager noted, “I think there’ll
16 be a new skillset. If you’re a level five, you’re not going to need a driver, but you’ll still need
17 technicians to repair the trucks, you’ll need computer folks to program the trucks.” This change
18 was viewed optimistically by some participants. A manager (age unknown) explained, “I have
19 faith that the ones that are in the industry now can adapt to new technology.” However, others
20 were concerned for individuals within the industry who may get lost as roles change. A 53-year-
21 old manager shared, “I think you’re going to lose a lot of people that won’t know where to
22 transition, that won’t know where to go.” See TABLE 3 for additional quotes.
23

24 [TABLE 3 About Here]

25 **5. Discussion**

26 AVs are projected to have wide-reaching impacts on society and the workforce. The trucking
27 industry is projected to be one of the first adopters of AVs, which will impact millions of driving
28 jobs. Decades long shortages of truck drivers, which were made visible by the COVID-19
29 pandemic, may hasten the industry’s adoption of AVs. This study advances our knowledge about
30 AV impacts by using online survey and focus group data to examine trucking industry workers’
31 views at three organizational levels (i.e., managers, supervisors, and drivers) about AVs as a
32 solution to persistent truck driver shortages. The present paper provides new perspectives about
33 AVs from trucking industry professionals, which is a different group of people than has been
34 considered given the large body of prior work focusing on AV perceptions of potential
35 consumers (85–89) or car industry professionals (90, 91). Given recent work indicating a lack of
36 alignment between experts and public perceptions of AVs (92) and the influence of the portrayal
37 of events related to AVs in the news media on public sentiment (93), it is important to examine
38 perspectives from other parts of society. Our analysis of these data provided several explanations
39 for the persistent driver shortage including an aging workforce, quality of life issues, and a lack
40 of qualified drivers with the necessary experience. Although companies have implemented
41 several solutions to these issues, driver shortages persist.

42 Additionally, our analysis produced new information about the industry perceptions of AVs to
43 solve the present driver shortage. Several participants believed that AVs could pose a potential

1 solution to the truck driver shortage if properly implemented. Specifically, they recognized the
2 potential for AVs to provide an incentive for more truckers to enter the industry through a
3 combination of improvements to road safety and appeal to the younger workforce. This aligns with
4 past literature that has reported technology utilization in trucking as a major attraction for younger
5 drivers (11). Other benefits reported by the participants included a general decrease in accidents,
6 and lower insurance costs, which have been widely noted in the literature (73). They also noted
7 that AVs may enable more people to participate in the profession that are not currently able to
8 because of lack of experience or a fear of particular aspects of driving (e.g., backing up trucks).
9 Some participants thought AVs may actually increase the number of jobs in the trucking industry,
10 particularly for people with technical skills that can repair and interact with automated trucks.
11 Previous studies have echoed similar findings, suggesting that automated truck operators may need
12 to acquire new technical skills (72).

13 However, some participants had a more pessimistic view of AVs and noted the hurdles to AV
14 adoption, citing issues with present infrastructure and liability. While not necessarily a positive or
15 negative, participants also noted the likelihood of continuing need for drivers in the vehicles, and
16 the changing role of industry positions that would emerge following any level of AV adoption.
17 Many also contended that, even with an increase in certain positions with AV adoption, some
18 sectors and job positions may be rendered obsolete, causing job loss for those who fail to adapt.
19 This is in line with the potential automation-induced job losses reported by previous studies (78,
20 79). From a practical perspective, these results provide an indication to industry leaders and
21 policymakers about the trucking industry's current views and preparedness for AV adoption. For
22 example, proactive training programs for technicians and drivers are needed to prepare them for a
23 future where automated vehicles are on the road. Interestingly, any changes to the workforce are
24 not anticipated to occur in the short term (2-5 years). Instead, these impacts are expected to occur
25 farther into the future. These viewpoints align with prior work indicating longer timelines for full
26 adoption of level 4 and 5 AVs (73).

27 That said, there are some limitations to this study that are important to mention. The first of
28 these limitations is that our findings may be specific to U.S. based companies and may differ from
29 the trucking workforce in other parts of the world. A second related limitation of this study is that
30 the sample, which is comprised of respondents from one Midwest and one Southern state, may not
31 be representative of trucking industry members in other U.S. states or other countries, who may
32 have political and cultural differences from the participants analyzed in this study. These
33 differences could impact their views about causes of the trucking shortage and associated impacts
34 of AVs. A third limitation is that this study does not make a distinction among the different types
35 of trucking (e.g., road trucking, parcel, or owner-operated) or different company sizes. Another
36 limitation of this study is that the data were collected over a period in time that coincided with the
37 COVID-19 pandemic, which was a tumultuous time for the trucking industry. The events of this
38 period, such as fluctuations in shipping demand and worker problems, may have influenced
39 participants' views. However, this tumult may also have prompted participants to think more
40 carefully about new solutions, including AVs, to trucking industry challenges. Lastly, the data
41 were collected from a fairly small number of participants (N=67) which may not represent all
42 workers in the industry. That said, the demographics of the study participants in this paper, as well

1 as many of the issues identified by participants, align with prior research (14, 19, 27, 31–33). Thus,
2 the number of participants does not appear to have impacted our analytical results.

3 These limitations provide opportunities for future research. One line of future work could
4 conduct repeated focus groups with the same participants over time to understand how temporal
5 distance from the pandemic changes or does not change their views on the utility of AVs as a
6 solution to the issue of truck driver shortages. This time series of data would also help us
7 understand how views about AVs change or do not change as mass deployment becomes a more
8 likely reality. A second line of future work could conduct ethnographic research about the trucking
9 industry to get a better sense of the knowledge, skills, and abilities (KSAs) the future trucking
10 workforce will need to stay competitive in an age of automation. This research approach would
11 permit time with workers on a daily basis for an extended period of time to make inquiries about
12 daily tasks drivers perform that may or may not be automated. These tasks may be so routine to
13 workers that they forget to mention them in a one-time focus group but are core tasks to driving
14 work.

15 **6. Conclusion**

16 The study findings indicate that the truck driving industry views the driver shortage as a
17 constant issue, which has implications for every aspect of industry operation. This shortage is
18 caused by problems within the trucking profession, as well as external forces that pull potential
19 workers to other workforce sectors. Given the necessity of a reliable and efficient supply chain, of
20 which trucking holds an invaluable and irreplaceable position, the potential of AVs as a solution
21 is one that can and must be contemplated. From our study, it is clear that AVs can be a valuable
22 asset for the industry moving forward, so long as particular concerns are addressed.

23

1 **References**

2. 1. American Trucking Associations. Economics and Industry Data.
3. <https://www.trucking.org/economics-and-industry-data>. Accessed Jun. 24, 2022.
4. 2. Mittal, N., P. D. Udayakumar, G. Raghuram, and N. Bajaj. The Endemic Issue of Truck
5. Driver Shortage - A Comparative Study between India and the United States. *Research in*
6. *Transportation Economics*, Vol. 71, 2018, pp. 76–84.
7. <https://doi.org/10.1016/j.retrec.2018.06.005>.
8. 3. All Trucking. 2021 Truck Driving Industry Statistics.
9. <https://www.alltrucking.com/articles/trucking-industry-statistics>. Accessed Jun. 24, 2022.
10. 4. American Transportation Research Institute. *Critical Issues in the Trucking Industry - 2022*.
11. 2022, p. 30.
12. 5. American Trucking Associations. *Driver Shortage Update 2021*. 2021.
13. 6. The White House. Fact Sheet: The Biden Administration's Unprecedented Actions to
14. Expand and Improve Trucking Jobs. *The White House*, Apr 04, 2022.
15. 7. Commendatore, C. Biden Admin Details Plan to Boost Trucker Jobs. *Bulk Transporter*.
16. <https://www.bulktransporter.com/regulations/article/21238373/biden-admin-details-plan-to-boost-truck-driver-jobs>. Accessed Jul. 3, 2022.
18. 8. Cassidy, W. US Labor Data Demonstrate Increase in Truck Drivers, Driver Pay. JOC.com,
19. May 18, 2015.
20. 9. U.S. Bureau of Labor Statistics. May 2022 National Occupational Employment and Wage
21. Estimates. *Occupational Employment and Wage Statistics*.
22. https://www.bls.gov/oes/current/oes_nat.htm. Accessed Jun. 22, 2023.
23. 10. Costello, B. *Truck Driver Shortage Analysis 2019*. American Trucking Associations, 2019.
24. 11. Leslie, A., and D. Crownover. *Integrating Younger Adults into Trucking Careers*. American
25. Transportation Research Institute, 2022.
26. 12. World Economic Forum. *Autonomous Trucks: An Opportunity to Make Road Freight Safer,*
27. *Cleaner and More Efficient*. 2021.
28. 13. McGehee, D. V., M. Brewer, C. Schwarz, and B. W. Smith. Review of Automated Vehicle
29. Technology: Policy and Implementation Implications. *TRID*, 2015.
30. 14. Richardson, N., F. Doubek, K. Kuhn, and A. Stumpf. Assessing Truck Drivers' and Fleet
31. Managers' Opinions towards Highly Automated Driving. *Advances in Intelligent Systems*
32. *and Computing*, Vol. 484, 2017, pp. 473–484. https://doi.org/10.1007/978-3-319-41682-3_40.
34. 15. Shankwitz, C. *Long-Haul Truck Freight Transport and the Role of Automation:*
35. *Collaborative Human - Automated Platooned Trucks Alliance (CHAPTA)*. Western
36. Transportation Institute, Montana State University, 2017.
37. 16. Leonard, J. J., D. A. Mindell, and E. L. Stayton. Autonomous Vehicles, Mobility, and
38. Employment Policy: The Roads Ahead. MIT Work of The Future, Massachusetts Institute
39. of Technology, Cambridge, MA, July, Jul, 2020, pp. 1–34.
40. 17. Simpson, J. R., S. Mishra, A. Talebian, and M. M. Golias. An Estimation of the Future
41. Adoption Rate of Autonomous Trucks by Freight Organizations. *Research in*
42. *Transportation Economics*, Vol. 76, 2019, p. 100737.
43. <https://doi.org/10.1016/j.retrec.2019.100737>.
44. 18. Slowik, P., and B. Sharpe. Automation in the Long Haul: Challenges and Opportunities of
45. Autonomous Heavy-Duty Trucking in the United States. *International Council On Clean*
46. *Transportation*, No. 2018–06, 2018, p. 30.

1 19. Bhoopalam, R. van den Berg, N. Agatz, and C. Chorus. The Long Road to Automated
2 Trucking: Insights from Driver Focus Groups. *SSRN*, 2021.
3 <https://dx.doi.org/10.2139/ssrn.3779469>.

4 20. Abraham, K. G., and S. N. Houseman. Short-Time Compensation Is a Missing Safety Net
5 for U.S. Economy in Recessions. *Employment Research*, Vol. 16, No. 3, 2009, pp. 3–3.
6 [https://doi.org/10.17848/1075-8445.16\(3\)-2](https://doi.org/10.17848/1075-8445.16(3)-2).

7 21. Srinivas, S., S. Ramachandiran, and S. Rajendran. Autonomous Robot-Driven Deliveries: A
8 Review of Recent Developments and Future Directions. *Transportation Research Part E:
9 Logistics and Transportation Review*, Vol. 165, 2022, p. 102834.
10 <https://doi.org/10.1016/j.tre.2022.102834>.

11 22. Suzuki, Y., M. R. Crum, and G. R. Pautsch. Predicting Truck Driver Turnover.
12 *Transportation Research Part E: Logistics and Transportation Review*, Vol. 45, No. 4,
13 2009, pp. 538–550. <https://doi.org/10.1016/j.tre.2009.01.008>.

14 23. Boyce, W. S. Does Truck Driver Health and Wellness Deserve More Attention? *Journal of
15 Transport & Health*, Vol. 3, No. 1, 2016, pp. 124–128.
16 <https://doi.org/10.1016/j.jth.2016.02.001>.

17 24. Thiese, M. S., G. Moffitt, R. J. Hanowski, S. N. Kales, Richard. J. Porter, and K. T.
18 Hegmann. Repeated Cross-Sectional Assessment of Commercial Truck Driver Health.
19 *Journal of Occupational and Environmental Medicine*, Vol. 57, No. 9, 2015, pp. 1022–
20 1027.

21 25. Day, J. C., and A. W. Hait. Number of Truckers at All-Time High. *U.S. Census Bureau*, Jun
22 06, 2019.

23 26. Short, J. *Analysis of Truck Driver Age Demographics across Two Decades*. American
24 Transportation Research Institute, 2014.

25 27. Staats, U., D. Lohaus, A. Christmann, and M. Woitschek. Fighting against a Shortage of
26 Truck Drivers in Logistics: Measures That Employers Can Take to Promote Drivers' Work
27 Ability and Health. *Work*, Vol. 58, No. 3, 2017, pp. 383–397.
28 <https://doi.org/10.3233/WOR-172626>.

29 28. Costello, B. *Truck Driver Shortage Analysis 2019*. American Trucking Associations, 2019.

30 29. Collingwood, L. Autonomous Trucks: An Affront to Masculinity? *Information &
31 Communications Technology Law*, Vol. 27, No. 2, 2018, pp. 251–265.
32 <https://doi.org/10.1080/13600834.2018.1458456>.

33 30. Schroer, R. Want This Job? An Exploratory Analysis of Differing Views towards Pursuing
34 a Truck Driving Career. *Diss. The Ohio State University*, 2020.

35 31. Min, H., and T. Lambert. Truck Driver Shortage Revisited. *Transportation Journal*, Vol.
36 42, No. 2, 2002, pp. 5–16.

37 32. Hege, A., M. K. Lemke, Y. Apostolopoulos, and S. Sönmez. The Impact of Work
38 Organization, Job Stress, and Sleep on the Health Behaviors and Outcomes of U.S. Long-
39 Haul Truck Drivers. *Health Education & Behavior*, Vol. 46, No. 4, 2019, pp. 626–636.
40 <https://doi.org/10.1177/1090198119826232>.

41 33. Passey, D. G., R. Robbins, K. T. Hegmann, U. Ott, M. Thiese, A. Garg, A. Kinney, and M.
42 A. Murtaugh. Long Haul Truck Drivers' Views on the Barriers and Facilitators to Healthy
43 Eating and Physical Activity: A Qualitative Study. *International Journal of Workplace
44 Health Management*, Vol. 7, No. 2, 2014, pp. 121–135. <https://doi.org/10.1108/IJWHM-08-2013-0031>.

1 34. Shattell, M., Y. Apostolopoulos, C. Collins, S. Sönmez, and C. Fehrenbacher. Trucking
2 Organization and Mental Health Disorders of Truck Drivers. *Issues in Mental Health
3 Nursing*, Vol. 33, No. 7, 2012, pp. 436–444.
4 <https://doi.org/10.3109/01612840.2012.665156>.

5 35. Johnson, J., B. Dennis, D. McClure, and K. Schneider. Determinants of Job Satisfaction
6 among Long-Distance Truck Drivers: An Interview Study in the United States.
7 *International Journal of Management*, Vol. 28, No. 1, 2011.

8 36. Shattell, M., Y. Apostolopoulos, S. Sönmez, and M. Griffin. Occupational Stressors and the
9 Mental Health of Truckers. *Issues in Mental Health Nursing*, Vol. 31, No. 9, 2010, pp. 561–
10 568. <https://doi.org/10.3109/01612840.2010.488783>.

11 37. Sousa, I. C., and S. Ramos. Working Conditions, Health and Retirement Intentions: A Case
12 Study of Truck Drivers. *International Journal of Workplace Health Management*, Vol. 11,
13 No. 3, 2018, pp. 114–129. <https://doi.org/10.1108/IJWHM-02-2018-0019>.

14 38. Hilton, M. F., Z. Staddon, J. Sheridan, and H. A. Whiteford. The Impact of Mental Health
15 Symptoms on Heavy Goods Vehicle Drivers' Performance. *Accident Analysis &
16 Prevention*, Vol. 41, No. 3, 2009, pp. 453–461. <https://doi.org/10.1016/j.aap.2009.01.012>.

17 39. Jailet, J. 80 Percent of Car-Truck Crashes Caused by Car Drivers, ATA Report Says.
18 *Commercial Carrier Journal*, Feb 25, 2020.

19 40. Federal Highway Administration. *Highway Statistics 2020*. U.S. Department of
20 Transportation, 2022.

21 41. Chen, G. X., W. K. Sieber, J. E. Lincoln, J. Birdsey, E. M. Hitchcock, A. Nakata, C. F.
22 Robinson, J. W. Collins, and M. H. Sweeney. NIOSH National Survey of Long-Haul Truck
23 Drivers: Injury and Safety. *Accident Analysis & Prevention*, Vol. 85, 2015, pp. 66–72.
24 <https://doi.org/10.1016/j.aap.2015.09.001>.

25 42. Lund, J., and C. Wright. More Pain, Less Gain: New Compensation Systems for Grocery
26 Truck Drivers. *Labor Studies Journal*, Vol. 29, No. 2, 2004, pp. 1–20.
27 <https://doi.org/10.1177/0160449X0402900201>.

28 43. Min, H. Examining Sources of Driver Turnover from a Managerial Perspective. *Journal of
29 Transportation Management*, 2002, pp. 59–69.

30 44. The Gallup Organization. *Empty Seats and Musical Chairs: Critical Success Factors in
31 Truck Driver Retention*. American Trucking Associations, Alexandria, VA, 1997.

32 45. Large, R. O., T. Breitling, and N. Kramer. Driver Shortage and Fluctuation: Occupational
33 and Organizational Commitment of Truck Drivers. *Supply Chain Forum: An International
34 Journal*, Vol. 15, No. 3, 2014, pp. 66–72.
35 <https://doi.org/10.1080/16258312.2014.11517352>.

36 46. LeMay, S. A., L. Johnson, Z. Williams, and M. Garver. The Causes of Truck Driver Intent-
37 to-quit: A Best-fit Regression Model. *International Journal of Commerce and
38 Management*, Vol. 23, No. 3, 2013, pp. 262–272. <https://doi.org/10.1108/IJCoMA-03-2013-0028>.

40 47. Ji-Hyland, C., and D. Allen. What Do Professional Drivers Think about Their Profession?
41 An Examination of Factors Contributing to the Driver Shortage. *International Journal of
42 Logistics Research and Applications*, Vol. 25, No. 3, 2020, pp. 231–246.
43 <https://doi.org/10.1080/13675567.2020.1821623>.

44 48. McKinnon, A., C. Flöthmann, K. Hoberg, and C. Busch. *Logistics Competencies, Skills,
45 and Training: A Global Overview*. World Bank, Washington, DC, 2017.

1 49. Seaton, H. The New E-Commerce/Home Delivery Retail Distribution Paradigm. *Journal of*
2 *Transportation Management*, Vol. 29, No. 1, 2018.
3 <https://doi.org/10.22237/jotm/1530446520>.

4 50. Rep. Mica, J. L. Moving Ahead for Progress in the 21st Century Act [MAP-21]. H. R.
5 4348, 2012.

6 51. Wade, T., S. Suttles, and L. Walters. Transportation Safety Regulations via the Electronic
7 Logging Device Mandate Can Affect Fresh Produce Shipment Costs. *Choices*, Vol. 36, No.
8 3, 2021, pp. 1–11.

9 52. Hooper, A., and D. Murray. *E-Commerce Impacts on the Trucking Industry*. American
10 Transportation Research Institute, 2019.

11 53. Federal Motor Carrier Safety Administration. Hours of Service of Drivers. *Federal*
12 *Register*, Vol. 76, No. 248, 2011.

13 54. Mabry, J. E., M. Camden, A. Miller, A. Sarkar, A. Manke, C. Ridgeway, H. Iridiastadi, T.
14 Crowder, M. Islam, S. Soccilich, and R. J. Hanowski. Unravelling the Complexity of
15 Irregular Shiftwork, Fatigue and Sleep Health for Commercial Drivers and the Associated
16 Implications for Roadway Safety. *International Journal of Environmental Research and*
17 *Public Health*, Vol. 19, No. 22, 2022, p. 14780. <https://doi.org/10.3390/ijerph192214780>.

18 55. Federal Motor Carrier Safety Administration. Hours of Service of Drivers. *Federal*
19 *Register*, Vol. 85, No. 105, 2020.

20 56. Hall, R. W., and A. Mukherjee. Bounds on Effectiveness of Driver Hours-of-Service
21 Regulations for Freight Motor Carriers. *Transportation Research Part E: Logistics and*
22 *Transportation Review*, Vol. 44, No. 2, 2008, pp. 298–312.
23 <https://doi.org/10.1016/j.tre.2007.07.007>.

24 57. Kemp, E., S. W. Kopp, and E. C. Kemp Jr. Take This Job and Shove It: Examining the
25 Influence of Role Stressors and Emotional Exhaustion on Organizational Commitment and
26 Identification in Professional Truck Drivers. *Journal of Business Logistics*, Vol. 34, No. 1,
27 2013, pp. 33–45. <https://doi.org/10.1111/jbl.12008>.

28 58. American Transportation Research Institute and Owner-Operator Independent Driver
29 Association Foundation. *COVID-19 Impacts on the Trucking Industry*. 2020.

30 59. Lemke, M. K., Y. Apostolopoulos, and S. Sönmez. A Novel COVID-19 Based Truck
31 Driver Syndemic? Implications for Public Health, Safety, and Vital Supply Chains.
32 *American Journal of Industrial Medicine*, Vol. 63, No. 8, 2020, pp. 659–662.
33 <https://doi.org/10.1002/ajim.23138>.

34 60. Sperry, D., A. M. Schuster, S. R. Cotten, S. Agrawal, E. Mack, N. Britt, and J. Liberman.
35 Trucking in the Era of COVID-19. *American Behavioral Scientist*, 2022.
36 <https://doi.org/10.1177/00027642211066039>.

37 61. Mack, E. A., S. Agrawal, and S. Wang. The Impacts of the COVID-19 Pandemic on
38 Transportation Employment: A Comparative Analysis. *Transportation Research*
39 *Interdisciplinary Perspectives*, Vol. 12, 2021, p. 100470.
40 <https://doi.org/10.1016/j.trip.2021.100470>.

41 62. Hernandez, S. V., A. Balthrop, S. Hernandez, and F. University of Arkansas. *Measures of*
42 *Freight Network Resiliency during the Covid-19 Pandemic*. Maritime Transportation
43 Research and Education Center (MarTREC), 2020.

44 63. Pilz, D., S. Schwerdfeger, and N. Boysen. Make or Break: Coordinated Assignment of
45 Parking Space for Breaks and Rest Periods in Long-Haul Trucking. *Transportation*

1 78. Mohan, A., and P. Vaishnav. Impact of Automation on Long Haul Trucking Operator-
2 Hours in the United States. *Humanities and Social Sciences Communications*, Vol. 9, No. 1,
3 2022, pp. 1–10. <https://doi.org/10.1057/s41599-022-01103-w>.

4 79. Gittleman, M., and K. Monaco. Truck-Driving Jobs: Are They Headed for Rapid
5 Elimination? *ILR Review*, Vol. 73, No. 1, 2020, pp. 3–24.
6 <https://doi.org/10.1177/0019793919858079>.

7 80. Scherr, Y. O., B. A. Neumann Saavedra, M. Hewitt, and D. C. Mattfeld. Service Network
8 Design with Mixed Autonomous Fleets. *Transportation Research Part E: Logistics and*
9 *Transportation Review*, Vol. 124, 2019, pp. 40–55.
10 <https://doi.org/10.1016/j.tre.2019.02.001>.

11 81. Talebian, A., and S. Mishra. Unfolding the State of the Adoption of Connected
12 Autonomous Trucks by the Commercial Fleet Owner Industry. *Transportation Research*
13 *Part E: Logistics and Transportation Review*, Vol. 158, 2022, p. 102616.
14 <https://doi.org/10.1016/j.tre.2022.102616>.

15 82. U.S. Census Bureau. Characteristics of Driver/Sales Workers and Truck Drivers.
16 *Census.gov*. <https://www.census.gov/data/tables/2017/demo/industry-occupation/truckers-acs17.html>. Accessed Jun. 22, 2023.

18 83. Patton, M. Q. *Qualitative Evaluation and Research Methods*, 2nd Ed. Sage Publications,
19 Inc, Thousand Oaks, CA, US, 1990.

20 84. Braun, V., and V. Clarke. Thematic Analysis. In *APA handbook of research methods in*
21 *psychology, Vol 2: Research designs: Quantitative, qualitative, neuropsychological, and*
22 *biological*, American Psychological Association, Washington, DC, US, pp. 57–71.

23 85. Rice, S., and S. R. Winter. Do Gender and Age Affect Willingness to Ride in Driverless
24 Vehicles: If so, Then Why? *Technology in Society*, Vol. 58, 2019, p. 101145.
25 <https://doi.org/10.1016/j.techsoc.2019.101145>.

26 86. Rice, S., S. R. Winter, R. Mehta, G. Tamilselvan, E. C. Anania, and M. N. Milner.
27 Identifying the Factors That Predict a Consumer’s Willingness to Ride in Various Types of
28 Driverless Vehicles. *Technology in Society*, Vol. 64, 2021, p. 101476.
29 <https://doi.org/10.1016/j.techsoc.2020.101476>.

30 87. Dirsehan, T., and C. Can. Examination of Trust and Sustainability Concerns in
31 Autonomous Vehicle Adoption. *Technology in Society*, Vol. 63, 2020, p. 101361.
32 <https://doi.org/10.1016/j.techsoc.2020.101361>.

33 88. Escandon-Barbosa, D., J. Salas-Paramo, A. I. Meneses-Franco, and C. Giraldo- Gonzalez.
34 Adoption of New Technologies in Developing Countries: The Case of Autonomous Car
35 between Vietnam and Colombia. *Technology in Society*, Vol. 66, 2021, p. 101674.
36 <https://doi.org/10.1016/j.techsoc.2021.101674>.

37 89. Othman, K. Public Acceptance and Perception of Autonomous Vehicles: A Comprehensive
38 Review. *AI and Ethics*, Vol. 1, No. 3, 2021, pp. 355–387. <https://doi.org/10.1007/s43681-021-00041-8>.

40 90. Liu, N., A. Nikitas, and S. Parkinson. Exploring Expert Perceptions about the Cyber
41 Security and Privacy of Connected and Autonomous Vehicles: A Thematic Analysis
42 Approach. *Transportation Research Part F: Traffic Psychology and Behaviour*, Vol. 75,
43 2020, pp. 66–86. <https://doi.org/10.1016/j.trf.2020.09.019>.

44 91. Rezaei, A., and B. Caulfield. Safety of Autonomous Vehicles: What Are the Insights from
45 Experienced Industry Professionals? *Transportation Research Part F: Traffic Psychology*
46 *and Behaviour*, Vol. 81, 2021, pp. 472–489. <https://doi.org/10.1016/j.trf.2021.07.005>.

1 92. Swain, R., V. Truelove, A. Rakotonirainy, and S.-A. Kaye. A Comparison of the Views of
2 Experts and the Public on Automated Vehicles Technologies and Societal Implications.
3 *Technology in Society*, Vol. 74, 2023, p. 102288.
4 <https://doi.org/10.1016/j.techsoc.2023.102288>.

5 93. Penmetsa, P., S. Okafor, E. Adanu, M. Hudnall, S. B. Ramezani, S. Holiday, and S. Jones.
6 How Is Automated and Self-Driving Vehicle Technology Presented in the News Media?
7 *Technology in Society*, Vol. 74, 2023, p. 102290.
8 <https://doi.org/10.1016/j.techsoc.2023.102290>.

9

1 **TABLE 1 Participant Characteristics**

	Total ^a (N=65)	Manager ^b (n=25)	Supervisor (n=20)	Driver ^c (n=22)
	N (%)			
<i>Age (years), M(SD)</i>	44.68 (12.46)	51.36 (11.45)	38.65 (9.48)	42.58 (12.12)
20 to 24 years	2 (3%)	0	1 (5%)	1 (5%)
25 to 34 years	16 (25%)	3 (13%)	7 (35%)	6 (32%)
35 to 44 years	11 (17%)	3 (13%)	6 (30%)	2 (11%)
45 to 54 years	15 (24%)	4 (17%)	5 (25%)	6 (32%)
55 to 64 years	17 (27%)	13 (54%)	1 (5%)	3 (16%)
65 years and over	2 (3%)	1 (4%)	0	1 (5%)
<i>Gender</i>				
Male	51 (78%)	22 (88%)	13 (65%)	17 (77%)
Female	14 (22%)	3 (12%)	7 (35%)	4 (18%)
<i>Race/Ethnicity</i>				
White	45 (69%)	21 (88%)	12 (60%)	14 (64%)
African American	11 (17%)	1 (4%)	5 (25%)	6 (27%)
Asian	3 (5%)	0	2 (10%)	0
Hispanic/Latino	2 (3%)	1 (4%)	1 (5%)	1 (5%)
American Indian/Alaska Native	1 (2%)	0	0	1 (5%)
More than one race	2 (3%)	0	0	2 (9%)
Other	1 (2%)	1 (4%)	0	0
<i>Tenure at company (years), M(SD)</i>	12.07 (12.79)	20.79 (14.12)	5.10 (4.29)	8.59 (10.68)

2 *Notes.* ^aMissing 4 age, 1 race/ethnicity, and 3 tenure at company responses. ^bMissing 1 age, 1
3 race/ethnicity, and 1 tenure at company responses. ^cMissing 3 age and 2 tenure at company
4 responses.

5

1 **TABLE 2 Workforce Impacts of Automated Vehicles**

	Total ^a (N=65)	Manager ^b (n=25)	Supervisor (n=20)	Driver ^c (n=22)
	N (%)			
The size of the U.S. workforce				
Decrease	29 (45%)	6 (25%)	10 (50%)	13 (62%)
Stay the Same	28 (43%)	16 (67%)	5 (25%)	7 (33%)
Increase	8 (12%)	2 (8%)	5 (25%)	1 (5%)
The size of your organization's workforce in the next:				
2 years				
Decrease	3 (5%)	0	1 (5%)	2 (10%)
Stay the Same	46 (71%)	17 (71%)	11 (55%)	18 (86%)
Increase	16 (25%)	7 (29%)	8 (40%)	1 (5%)
5 years				
Decrease	9 (14%)	0	4 (20%)	5 (25%)
Stay the Same	37 (58%)	16 (67%)	6 (30%)	15 (75%)
Increase	18 (28%)	8 (33%)	10 (50%)	0
10 years				
Decrease	20 (32%)	7 (30%)	7 (35%)	9 (45%)
Stay the Same	26 (41%)	12 (52%)	6 (30%)	8 (40%)
Increase	17 (27%)	4 (17%)	7 (35%)	3 (15%)

2 *Notes.* ^aMissing 2 responses for size of U.S. workforce, 2 responses for change in next 2 years, 3 responses for change in next 5 years, and 4 responses for change in next 10 years. ^bMissing 1 response for size of U.S. workforce, change in next 2 years, and change in next 5 years. Missing 2 responses for change in next 10 years. ^cMissing 1 response for size of U.S. workforce and change in next 2 years. Missing 2 responses for change in next 5 years and change in next 10 years.

1 TABLE 3 Additional Quotes

Themes	Quotes
Theme 1: Driver Shortage	
Aging Workforce	<p>Our average age of driver that we have currently is right around the 50 mark. <i>50-year-old driver</i></p> <p>...most of the drivers I have, have been driving for a long time, and in the next 10 years will probably be retired. I don't have any younger drivers at this point in time. <i>59-year-old manager</i></p> <p>But it's a growing age. I mean, the average age of a long-haul truck driver is 55+ and it's not getting younger. it's a dwindling industry of that age-type. <i>42-year-old supervisor</i></p>
Quality of Life	<p>it's [truck driving] not a glamor job and it's very underrated and I just don't see... And very underpaid. You definitely are underpaid. <i>50-year-old driver</i></p> <p>...they (drivers) all want to get home. They don't want to go over the road. <i>60-year-old manager</i></p> <p>I mean, retirement and health and job stability is always an issue for drivers. They're always moving around- they're always looking for a company that'll pay 'em just a little bit more. <i>33-year-old supervisor</i></p>
Experience	<p>...truck driving is not the profession that it used to be. We don't get as many people. When I was young I wanted to be a truck driver, and I've been doing it since I was 19, and I'm 65. So, if the kids don't see it as a profession anymore. They see it as just an easy way to make money. And I really think that people need to... we need to figure out how to get better trained drivers. So, I see that as a challenge for us. <i>65-year-old driver</i></p> <p>Today, a driver has to have a fairly high skill level, a CDL and of course experience. And probably, depending on what level you're at and how much assistance really needs to happen, we are of the opinion that there'll be some opportunity for either a younger driver possibly. Today, it's 21. Maybe an 18 year old or a person who doesn't have all the skills of today's CDL driver.</p>

Themes	Quotes
	<p>But that's the big challenge right there, is the drivers, and that's a very big challenge in trucking is not just getting any driver, getting a good driver. <i>57-year-old supervisor</i></p>
Theme 2: Current Strategies Used to Address Driver Shortages	
Hire less experienced drivers	<p>... bringing in less experienced people, because right now, that's a big part of what they require of us. So I do think, in theory, we'll have more opportunities to bring in people if the barriers were lowered appropriately. <i>27-year-old manager</i></p> <p>It's an aging workforce... I think also the flip side of that is the standards for incoming drivers has gone down in order to get more. <i>25-year-old supervisor</i></p>
Provide better pay and company benefits	<p>We also have longevity bonuses, sign-on bonuses, safety bonuses. I feel like I'm forgetting a couple of the bonuses. We have so many bonuses. That's all geared at retaining the talent as well as attracting new talent. We find that if we really take care of our employees and our contractors, that good will spreads much further than any algorithm is going to find good drivers, but I do try to employ both of them just because we've had success both on avenues. <i>52-year-old manager</i></p> <p>You really have to open the pocket book and we pay guarantees to our drivers daily. <i>27-year-old supervisor</i></p>
Drivers home more frequently	<p>I continuously work at the lifestyle to get to the point where people can if they choose to be home every night, and I've got to build that... I've got to meet the driver's needs, there's no way around it. <i>55-year-old manager</i></p> <p>I do have drivers that get to be home every day. And then I have drivers that go out for a week. And drivers beyond that, if they want to go out for longer than a week, I leave that up to them. I have some drivers that love to be out for a month, two months at a time, that's up to them, my company, we say a week out and then the rest is up to you, if you want to stay out, then stay out, you know. So we like that we're flexible like that with our drivers. <i>34-year-old supervisor</i></p>

Themes	Quotes
Go outside of the U.S. to find truck drivers*	Now, the drivers that we hire out of Mexico, they do it, and I have a quite a few young guys in that part of the fleet, they do it because the money's good. They're going to drive, whether they drive it in Mexico, but if they get a B-1 visa and drive in the US, they're all over that. <i>72-year-old manager</i>
Theme 3: AVs as a Solution to Driver Shortages	
Advantages of AVs	Maybe we'd be in less accidents...less accidents means less ambulance chasers, less insurance. I think insurance would go down, which would mean the costs overall would go down. Maybe that means more money in our pocket. Not necessarily, but maybe. <i>31-year-old driver</i>
	Essentially, it [AV] could potentially, you know, fill in some of those gaps. If it's a short, if it's a manageable space [route]. Easy, simple and smooth. I wouldn't expect it to go across the country. Something in one area. <i>39-year-old supervisor</i>
	The level four thing, where you've got a guy in the truck to deal with the stuff that we think we need to, but it's largely driving that truck, taking the human element out, being safer, is that going to make the roads safer to the extent that trucks are at fault in accidents? Yes, although even AAA says that 80% of the accidents out there are the car's fault, not the truck's. So driving down our insurance costs, making the road safer, again, level four makes a lot of sense. <i>59-year old manager</i>
Continued need for drivers	I could definitely see that, hey, at the most we would be um level four autonomous wise because the DOT would highly prefer that, hey, we have a driver there just in case if something were to happen, or yeah, just safety reasons wise and insurance purposes. <i>24-year-old driver</i>
	I don't know or feel that there will be technology to solve all the problems that are out there as far as rescheduling and over short damage issues, breakdowns, you're gonna need that human touch to solve those problems and fixing equipment is a big, big part of that. <i>38-year-old supervisor</i>
	if you got to move something as power-only, where it's already loaded on a trailer, there's a mechanical breakdown. You're still going to have that, and that's something where you kind of need that human interaction. <i>37-year-old manager</i>

Themes	Quotes
Changing trends of industry positions	<p>So I think with drivers, a company per se, trying to protect our job as drivers, I don't know that that would happen...: I think they would look at us and say, "You need to change your skills a little bit and learn different skills and new skills." <i>50-year-old driver</i></p> <p>I think once the automated trucks going to come out, the shippers and receivers going to be trained to secure, and unsecure the freight, and maybe there's going to be some stations in between if the automated truck pulls in and somebody checks the freight. <i>40-year-old manager</i></p> <p>Securement. That's going to be a big one. Having people stationed at these facilities just to secure material on to trailers. You're going to have damage out there like crazy. These trucks are going to be ran without a human aspect that's going to be mindful of filters, to get them changed. So you're going to have different truck stop locations with people dedicated to just serving these automated units that's pulling in. So the maintenance area is going to boom because you no longer have that truck driver that know how to fix the light, or that truck driver that know how to switch out a mud flap or whatever it might be. You're taking that away, so they're going to be stationed at these ports. <i>31-year-old supervisor</i></p>

1 *Note.* * Discussed by two participants

1 Appendix A: Focus Group Protocol

2 *Introduction to AVs*

3 Before we begin the interview, we want to elaborate on what we mean by automated vehicles.

4

5 When people refer to automated vehicles, they talk about different levels: Automated vehicles
6 are defined in 5 levels, from 0 (with no automation) through 5 (highest level of automation). For
7 the purposes of this study, we are mainly interested in the higher levels – Levels 2, 3, and 4. And,
8 ultimately 5 – full automation.

9

- 10 • In Level 2 (L2) vehicles, the vehicle performs the control functions, but the human driver is
responsible for monitoring the driving environment and taking control when necessary.
- 11 • In Level 3 (L3) vehicles, the vehicle does most of the driving, but requires and requests
transition to human driver control and monitoring when needed.
- 12 • And in Level 4 (L4), no human driver assistance is needed, but the vehicle only operates in a
defined ODD (operational design domain), such as a defined urban area, or on limited access
highways.
- 13 • Level 5 (L5) – vehicle does all the driving functions under all conditions.

14

15 *Focus Group Questions*

16

- 17 1. Overall, what is your life like as a [manager, supervisor, driver]?
 - 18 a. What is the job like?
 - 19 b. What does a typical day look like?
- 20 2. What are the biggest challenges you encounter in your job currently?
- 21 3. Do you foresee any challenges moving forward for the job of truck driving?
- 22 4. Where do you see the truck driver job being in 2, 5, and 10 years?
 - 23 a. Do you see this job as continuing, and [for drivers] do you still want to continue in this
job?
- 24 5. What knowledge, skills, and abilities (KSAs) are needed to do the job of truck driving?
 - 25 a. Which of these KSAs could be automated or replaced by a computer or other types of
machines?
- 26 6. How do you think AVs will impact the job of truck driving in 2, 5, and 10 years?
 - 27 a. Will drivers need to learn new skills?
 - 28 b. What are your thoughts about whether the job of truck driving will change or go away?
- 29 7. What do you know about AVs? What do you think will be the impact of AVs on the job of
truck driving?
- 30 8. Is there anything else related to your job, AVs, or your quality of life that we haven't asked
you today that you would like to share with us?
- 31 9. What impact has COVID had on your company and driving jobs?
- 32 10. What do you think is the most important question that we asked you today? Why?